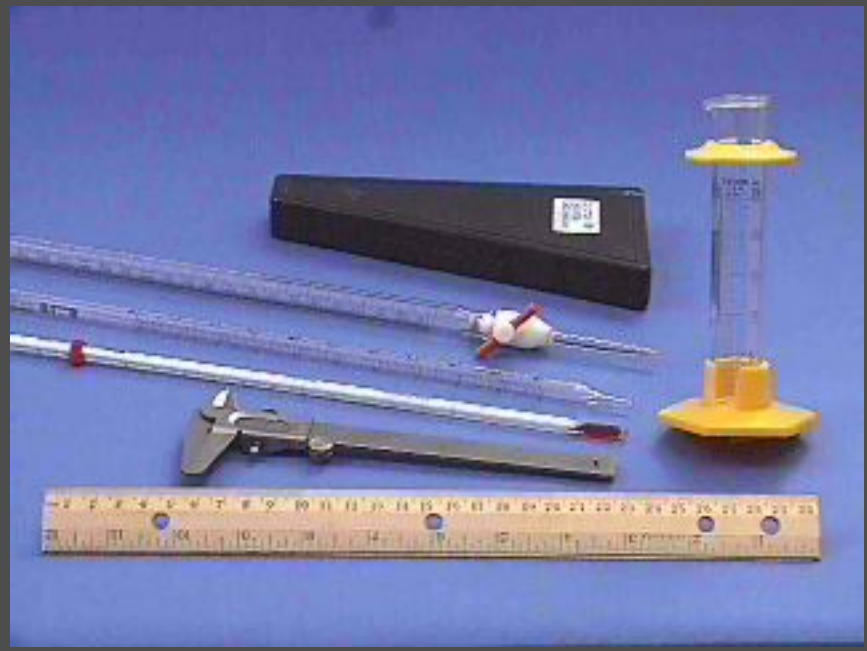
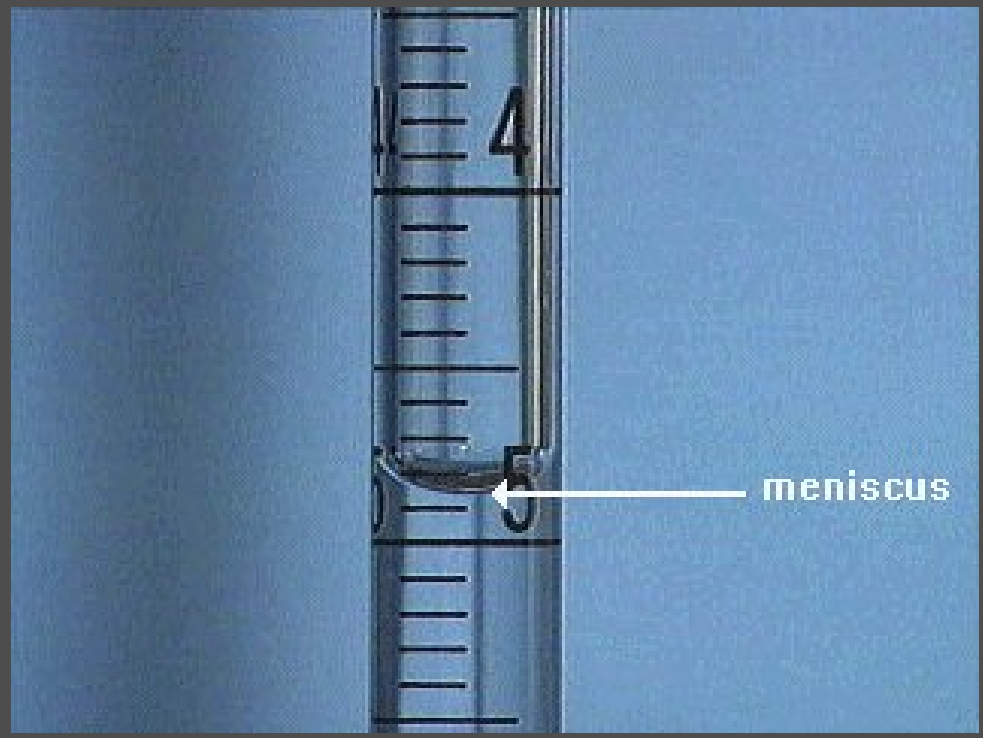
Measuring

- Volume
- Temperature
- Mass



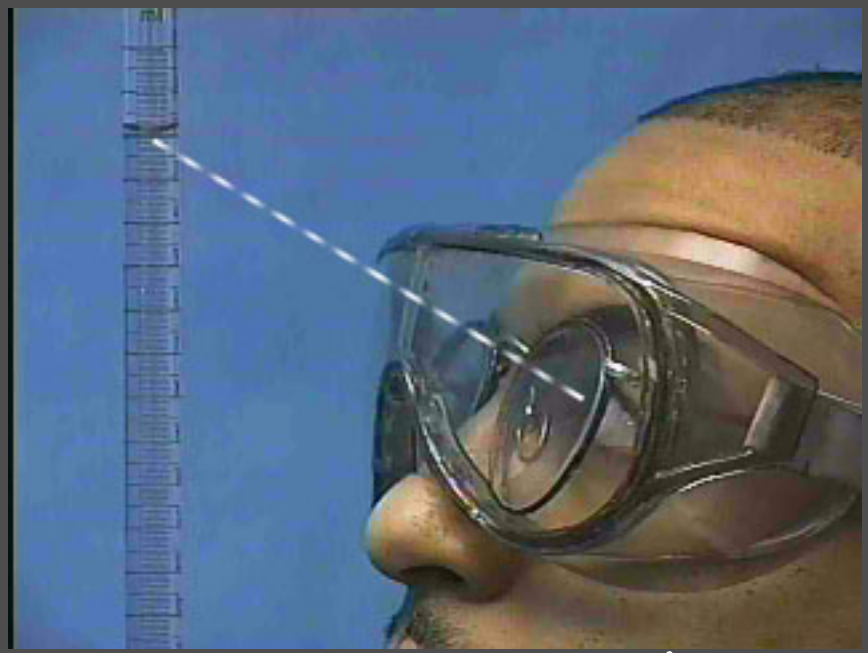
Reading the Meniscus

Always read volume from the bottom of the meniscus. The meniscus is the curved surface of a liquid in a narrow cylindrical container.

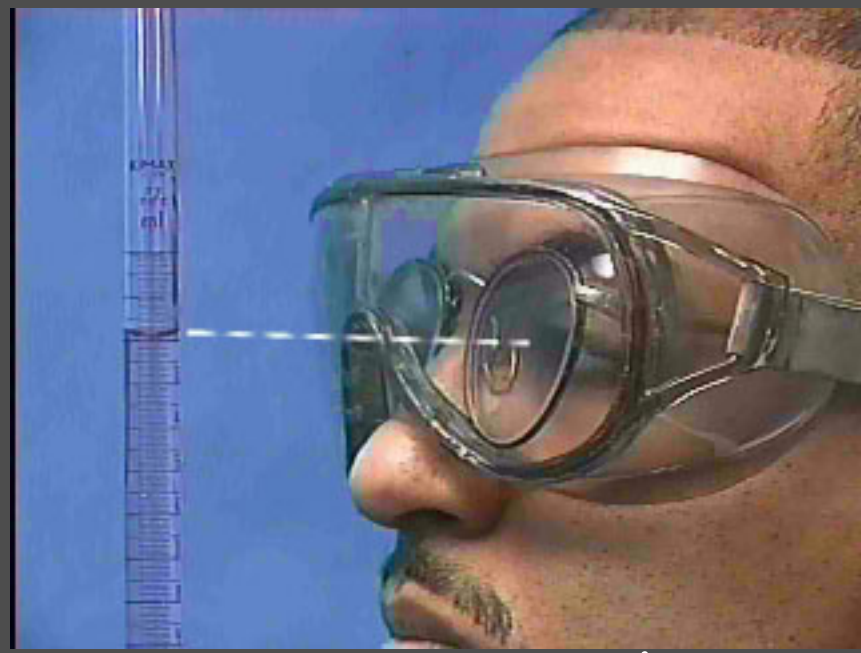


Try to avoid parallax errors.

Parallax errors arise when a meniscus or needle is viewed from an angle rather than from straight-on at eye level.



Incorrect: viewing the meniscus from an angle



Correct: Viewing the meniscus at eye level

Graduated Cylinders

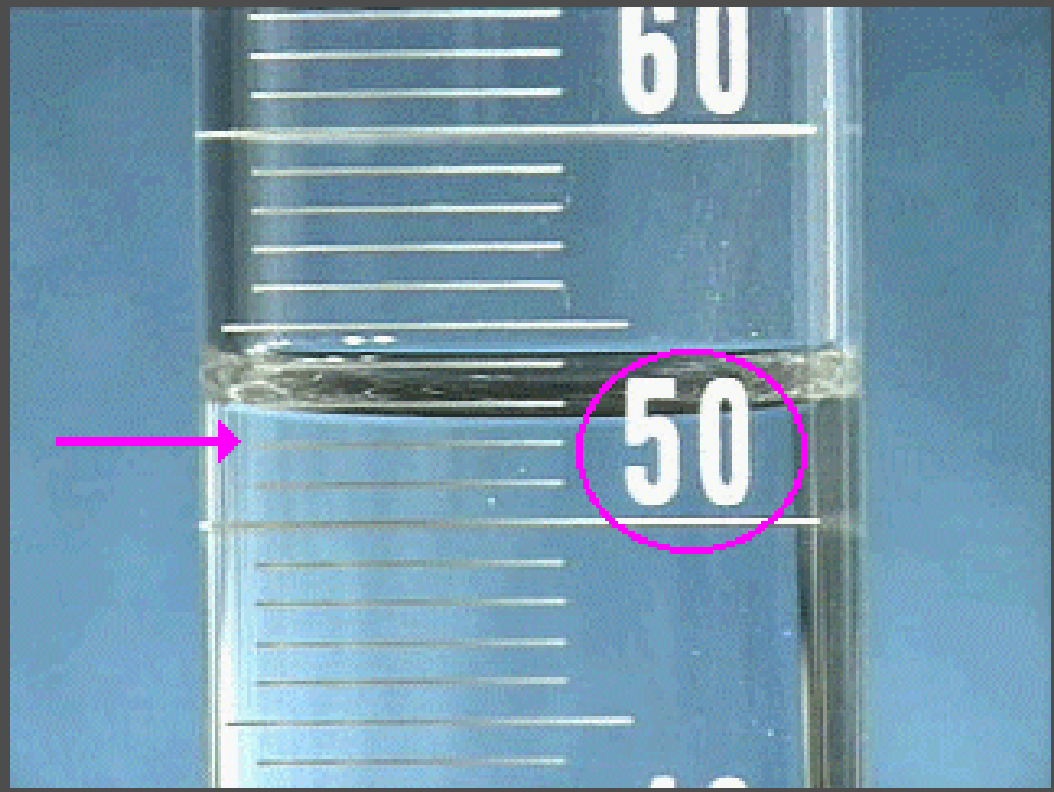
The glass cylinder has etched marks to indicate volumes, a pouring lip, and quite often, a plastic bumper to prevent breakage.

Measuring Volume

- Determine the volume contained in a graduated cylinder by reading the bottom of the meniscus at eye level.
- Read the volume using all certain digits and one uncertain digit.
  - Certain digits are determined from the calibration marks on the cylinder.
  - The uncertain digit (the last digit of the reading) is estimated.

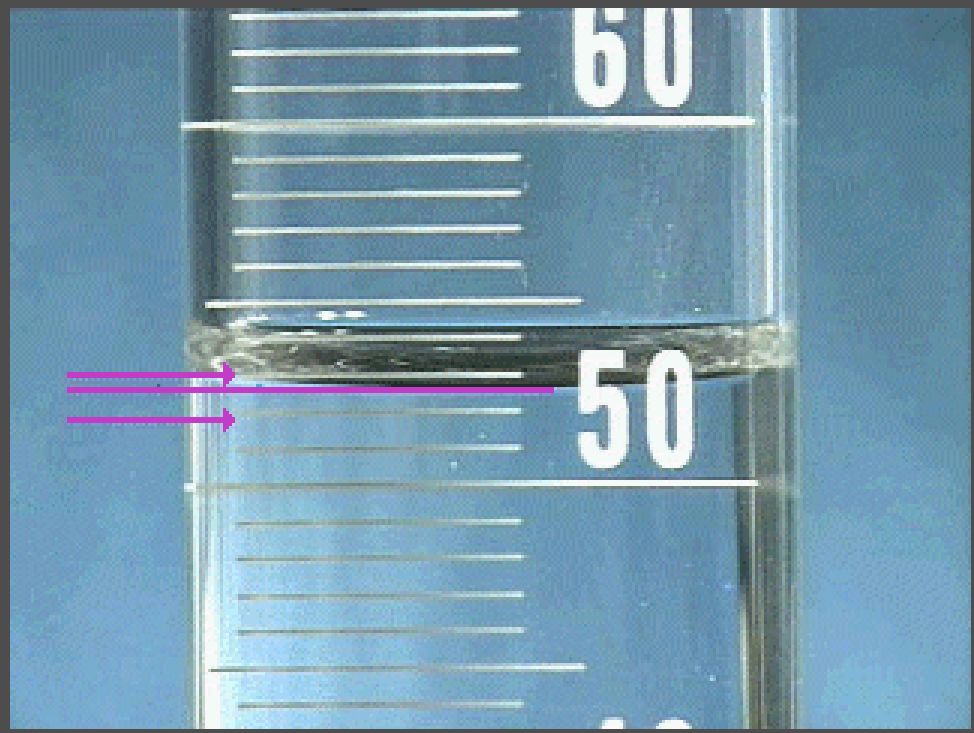
Use the graduations to find all certain digits

There are two unlabeled graduations below the meniscus, and each graduation represents 1 mL, so the certain digits of the reading are… 52 mL.



Estimate the uncertain digit and take a reading

The meniscus is about eight tenths of the way to the next graduation, so the final digit in the reading is 0.8 mL .



The volume in the graduated cylinder is 52.8 mL.

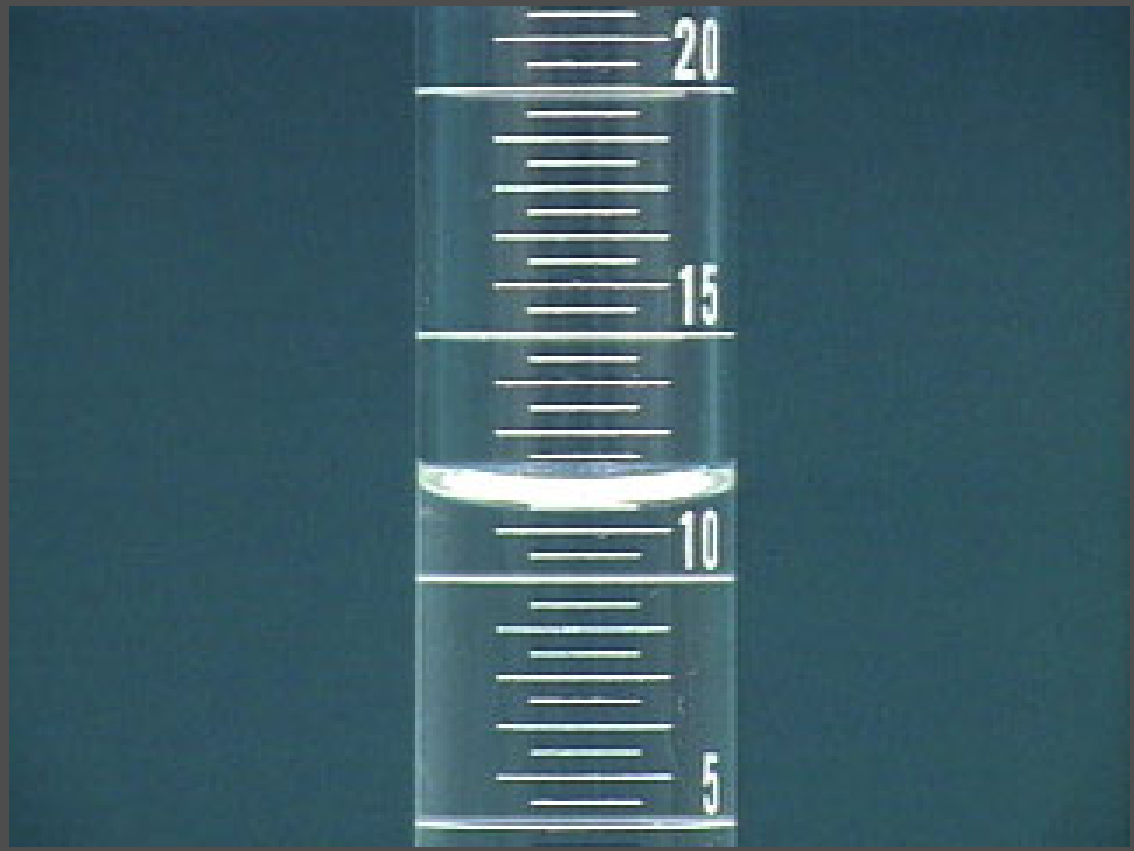
10 mL Graduate

What is the volume of liquid in the graduate?

6 . 6 2 mL

25mL graduated cylinder

What is the volume of liquid in the graduate?

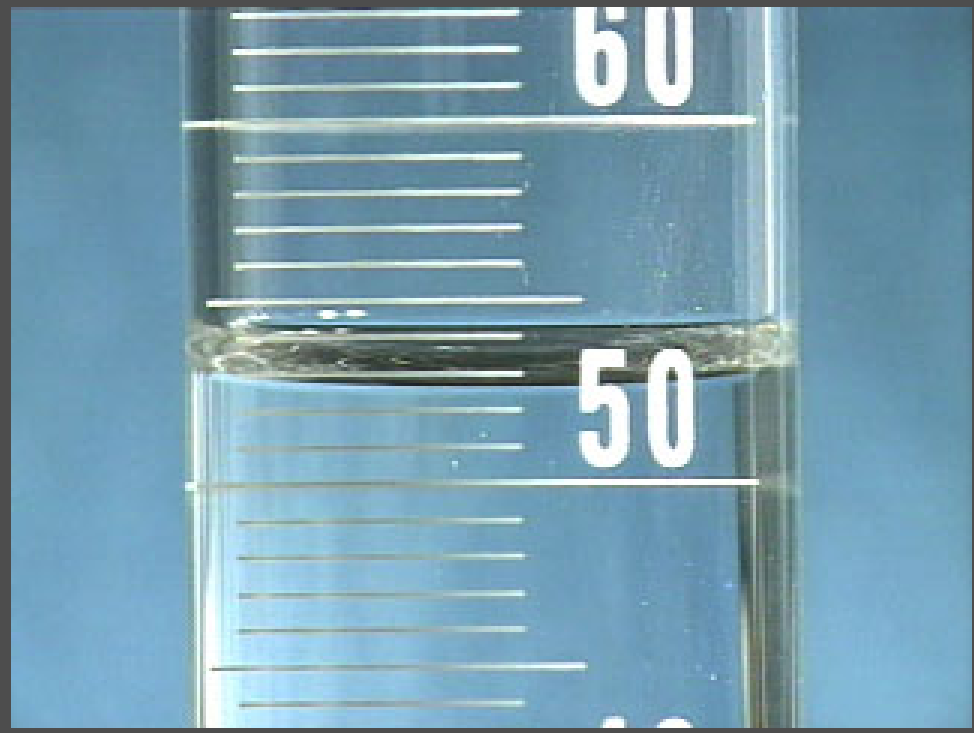


1 1 . 5 mL

100mL graduated cylinder

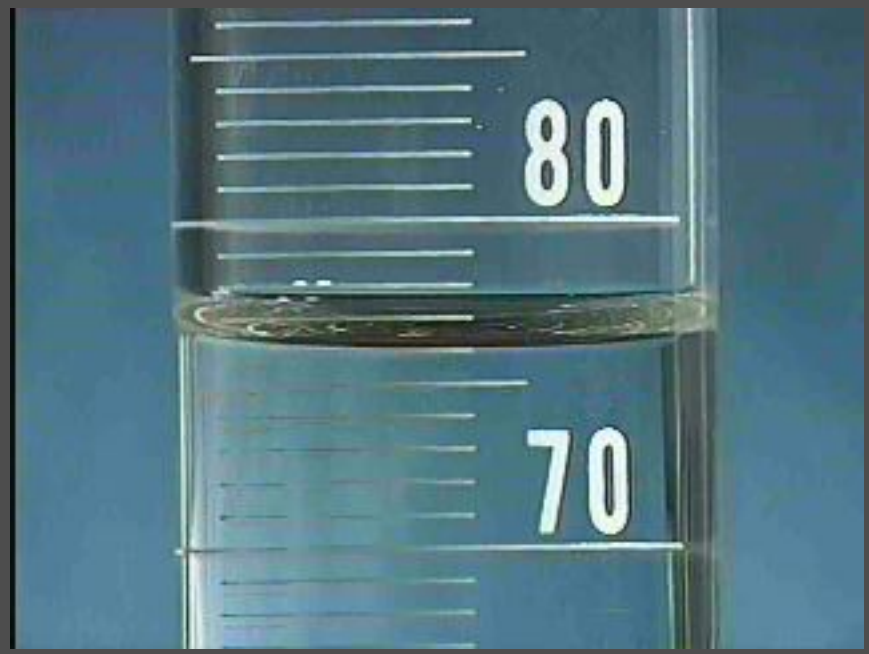
What is the volume of liquid in the graduate?

5 2 . 7 mL



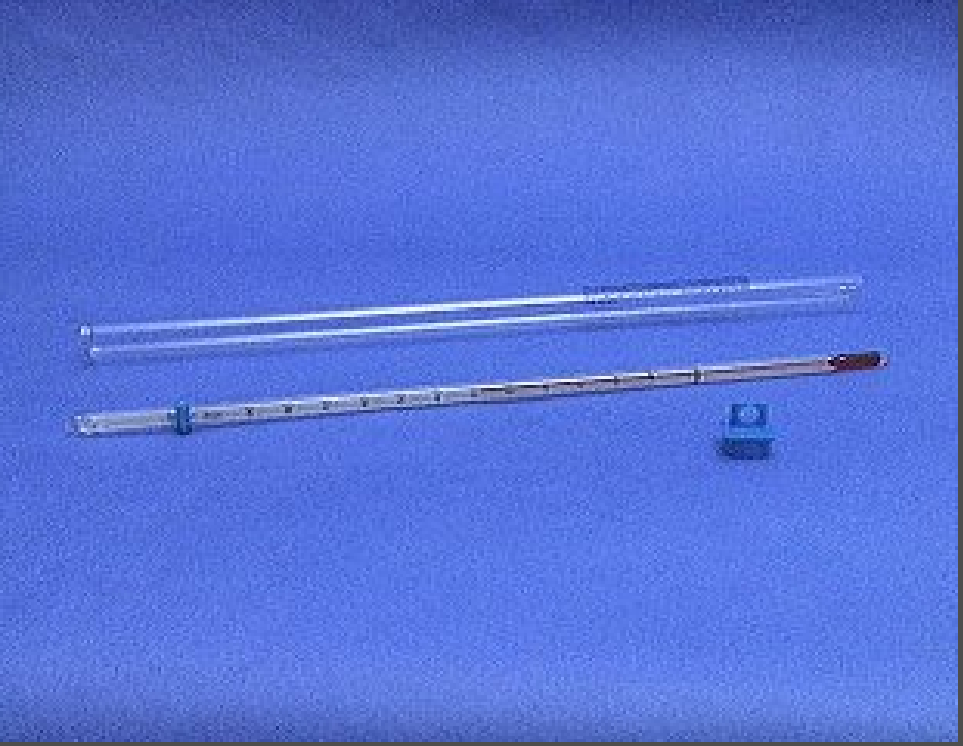
Self Test

Examine the meniscus below and determine the volume of liquid contained in the graduated cylinder.



The cylinder contains:

7 6 . 0 mL

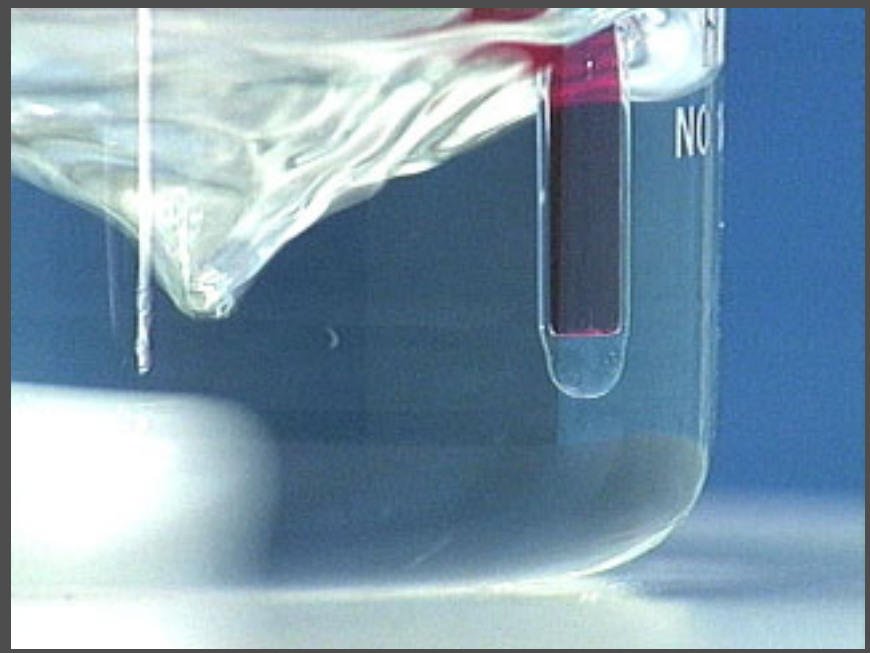


The Thermometer

- Determine the temperature by reading the scale on the thermometer at eye level.
- Read the temperature by using **all certain** digits and **one uncertain** digit.
- **Certain** digits are determined from the calibration marks on the thermometer.
- The **uncertain** digit (the last digit of the reading) is estimated.
- On most thermometers encountered in a general chemistry lab, the tenths place is the uncertain digit.

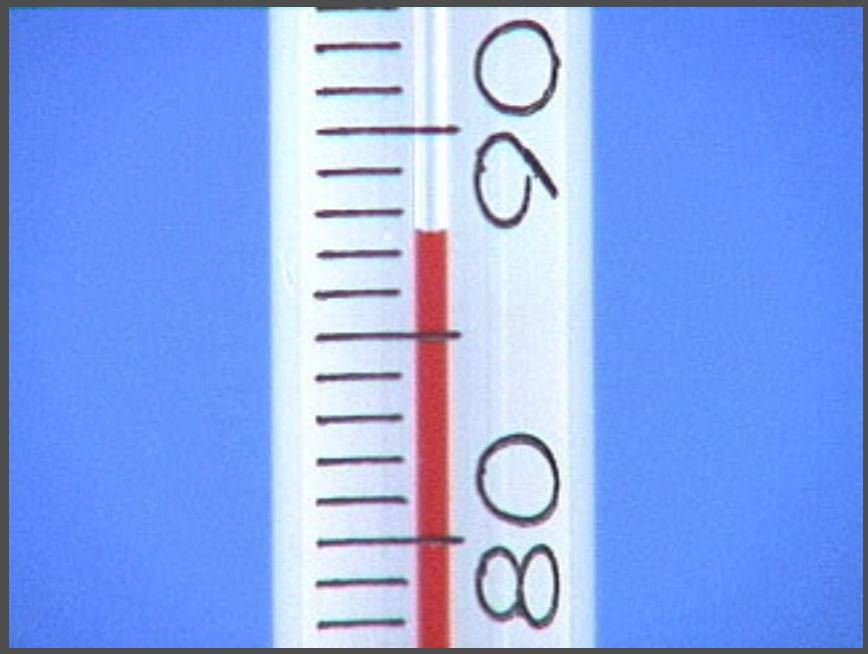
Do not allow the tip to touch the walls or the bottom of the flask.

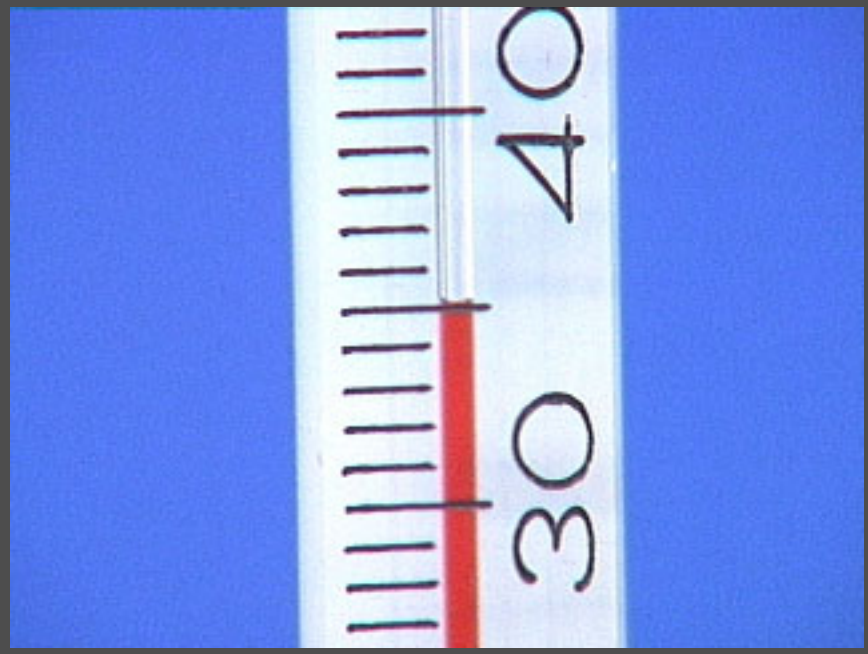
If the thermometer bulb touches the flask, the temperature of the glass will be measured instead of the temperature of the solution. Readings may be incorrect, particularly if the flask is on a hotplate or in an ice bath.



Reading the Thermometer

Determine the readings as shown below on Celsius thermometers:

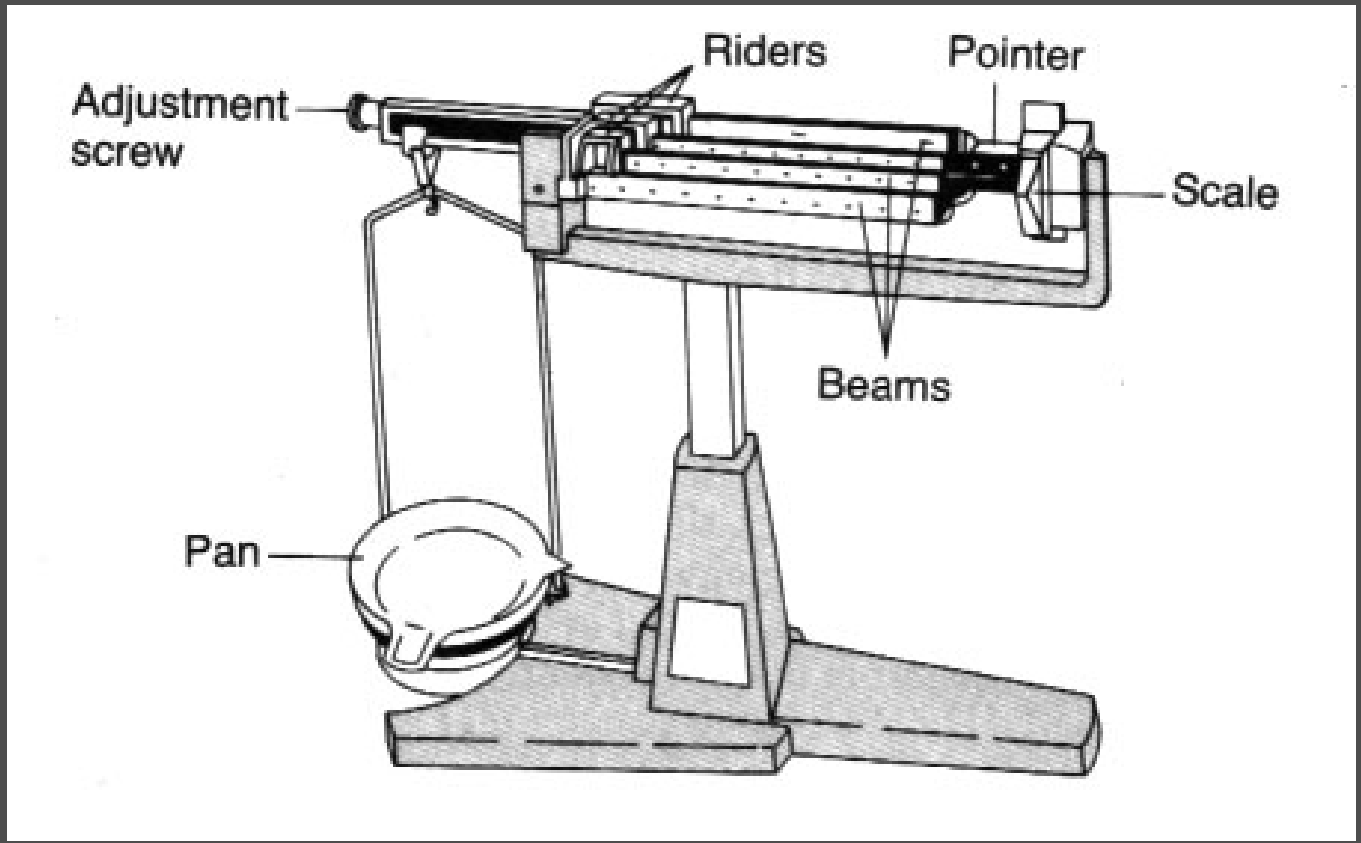




8 7 . 4 °C

3 5 . 0 °C

Measuring Mass – The Beam Balance



Our balances have 4 beams – the uncertain digit is the thousandths place (_ _ _ . _ _ X)

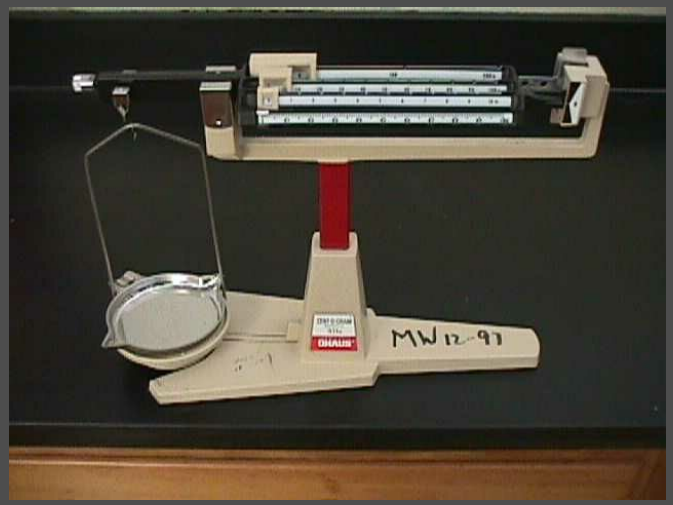
Balance Rules

In order to protect the balances and ensure accurate results, a number of rules should be followed:

- Always check that the balance is level and zeroed before using it.
- Never weigh directly on the balance pan. Always use a piece of weighing paper to protect it.
- Do not weigh hot or cold objects.
- Clean up any spills around the balance immediately.

Mass and Significant Figures

- Determine the mass by reading the riders on the beams at eye level.
- Read the mass by using <u>all certain</u> digits and <u>one uncertain</u> digit.



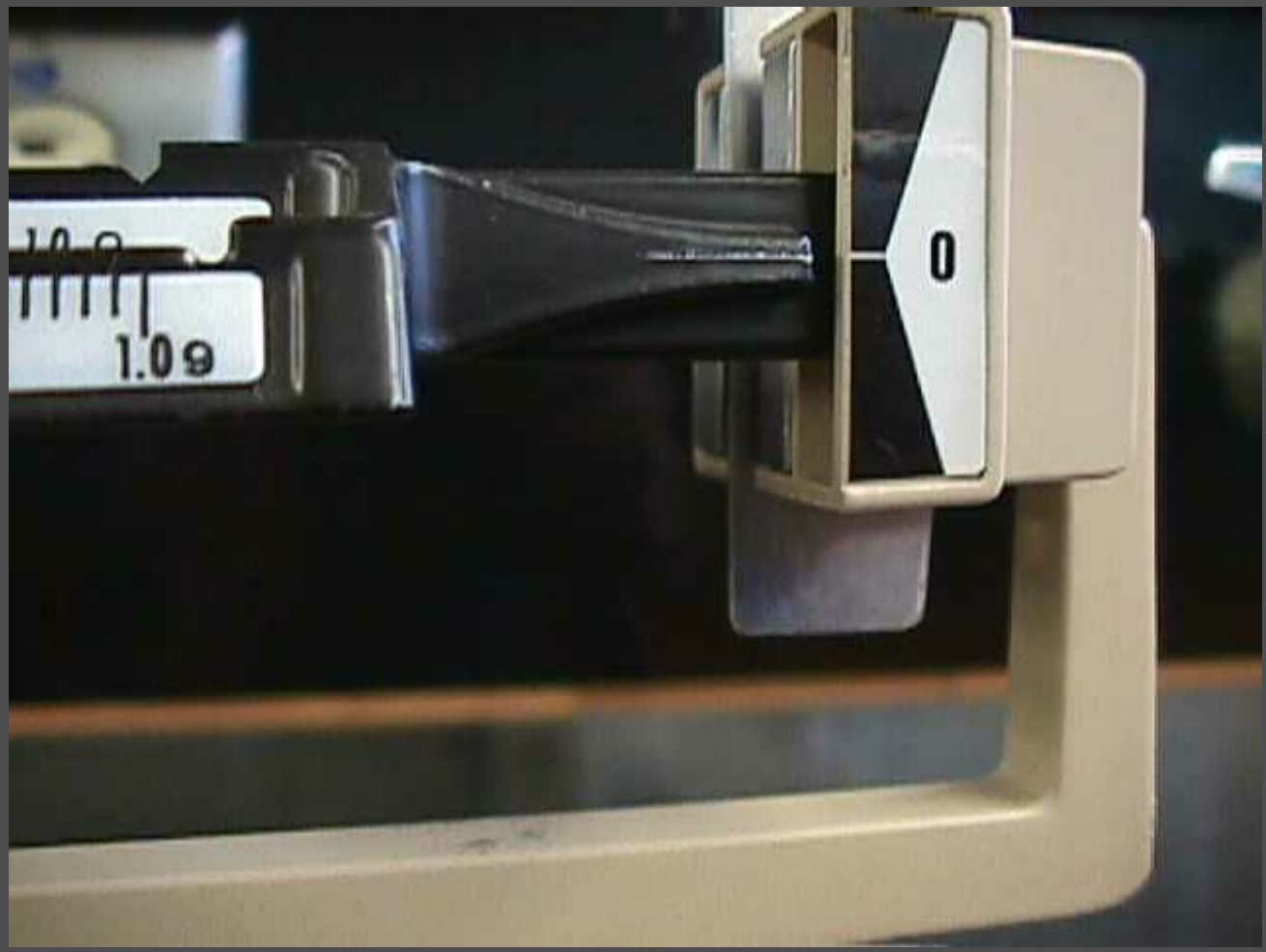
- The **uncertain** digit (the last digit of the reading) is estimated.
- On our balances, the **thousandths place** is uncertain.

Determining Mass

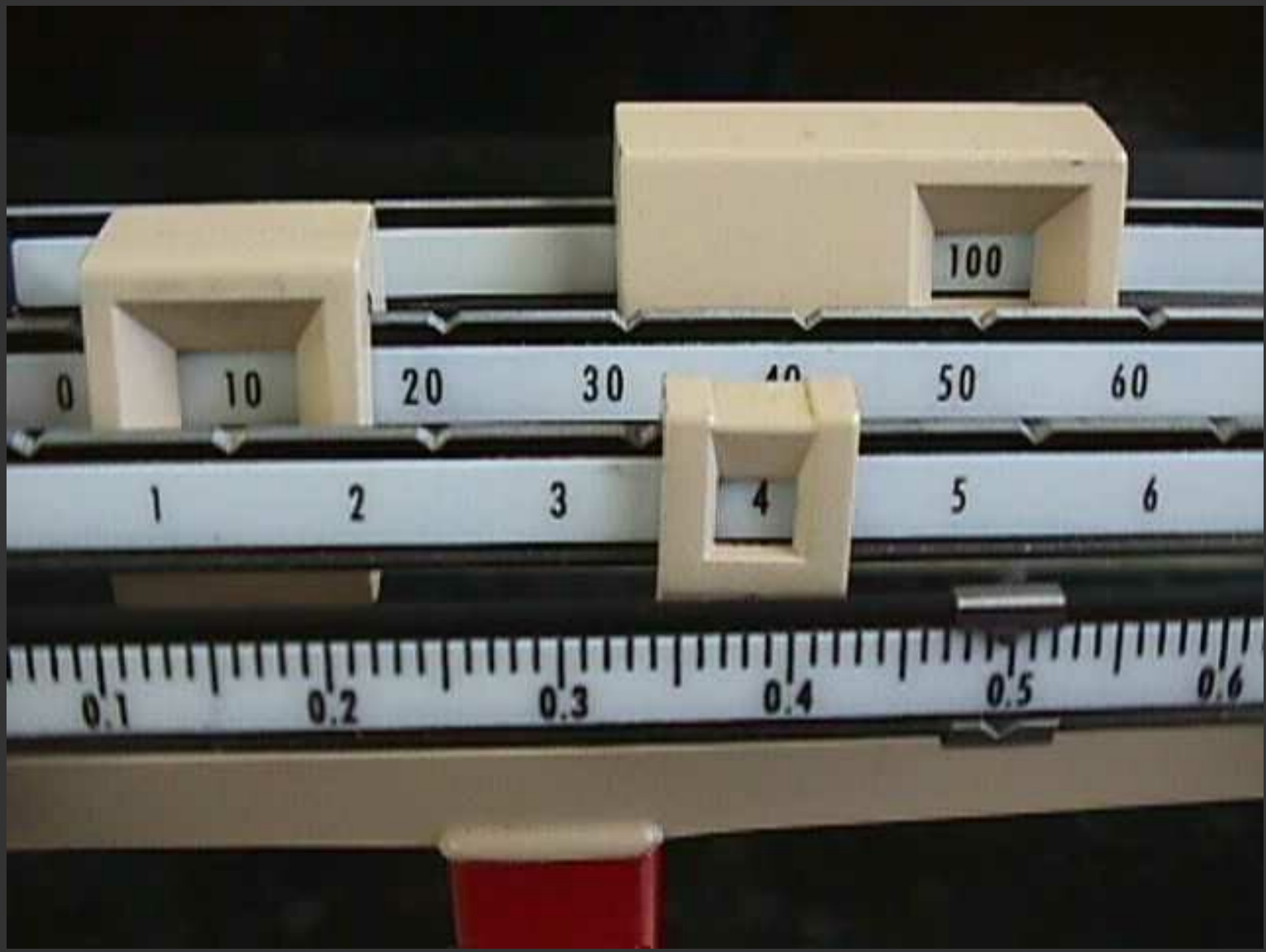
1. Place object on pan

2. Move riders along beam, starting with the largest, until the pointer is at the zero mark

Check to see that the balance scale is at zero



1 1 4 . ? ? ?



1 1 4 . 4 9 7